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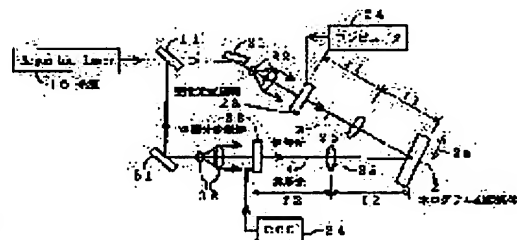
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**(54) INFORMATION MEDIA, OPTICAL RECORD METHOD, OPTICAL RECORDER, OPTICAL READ METHOD AND OPTICAL READER**
**(57)Abstract:**

**PROBLEM TO BE SOLVED:** To surely prevent forgeries, alterations, copies, data alterations and unauthorized uses of such information media as various cards and also to easily rewrite information.

**SOLUTION:** Data information is shown as a two-dimensional image on a spatial optical modulator 23 and the intensity of signal light 3 is modulated in two dimensions. An image-pickup device 34 picks up the image of a fingerprint of an authenticated person as a two-dimensional image, the two-dimensional image is shown on a spatial optical modulator 33 and the intensity of a reference beam 4 is modulated into two dimensions. At the same time, a hologram recording medium 2 is irradiated with the light 3, which passed through the modulator 23 and the beam 4 which passed through the modulator 33, and a hologram that results in interference with the light 3 which is modulated by data information and the beam 4 is modulated by a fingerprint is recorded on the medium 2. The authenticated person can have an image-pickup device 34 read his own fingerprint and have it read recorded data information. Even if a third person has the device 34 read his own fingerprint, he cannot read the recorded data information.

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**CLAIMS**

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[Claim(s)]

[Claim 1] Information media characterized by the key information which prevents that said data information is read by persons other than those with whom said 2nd wave front was attested in the information media which recorded the hologram on the hologram record section by making the 1st wave front which has data information interfere with the 2nd wave front for reference becoming irregular.

[Claim 2] Information media to which said key information is characterized by being the two-dimensional image or code formed in those who were attested from the information on a proper in information media according to claim 1.

[Claim 3] Information media to which information on a proper is characterized by being a person's attested fingerprint, a sign, print of a seal, facies, the iris, either of the personal identification numbers, or those combination in information media according to claim 2 at those [ said ] who were attested.

[Claim 4] Information media characterized by being the giant molecule or liquid crystal polymer which has the radical which said hologram record section photoisomerizes to a side chain in information media according to claim 1 to 3.

[Claim 5] Information media characterized by being the giant molecule which distributed the molecule which said hologram record section photoisomerizes in information media according to claim 1 to 3.

[Claim 6] Information media characterized by said radical or molecule to photoisomerize being a thing containing an azobenzene frame in information media according to claim 4 or 5.

[Claim 7] Information media characterized by said macromolecules or polymer liquid crystals being at least one sort of monomer polymers chosen from the polyester group in information media according to claim 4 to 6.

[Claim 8] Information media characterized by said hologram record section being the giant molecule which distributed the xanthene dye in information media according to claim 1 to 3.

[Claim 9] Information media to which it is characterized by said xanthene dye being erythrosin B, eosine Y, or uranine in information media according to claim 8.

[Claim 10] Information media to which it is characterized by said giant molecule being polymethylmethacrylate or polyvinyl alcohol in information media according to claim 5 or 8.

[Claim 11] Information media to which said hologram record section is characterized by being a photorefractive ingredient in information media according to claim 1 to 3.

[Claim 12] Information media to which said photorefractive ingredient is characterized by being LiNbO<sub>3</sub>, BaTiO<sub>3</sub>, or a photorefractive polymer in information media according to claim 11.

[Claim 13] Information media characterized by said hologram record section being the photopolymer which produces refractive-index change by the photopolymerization reaction in information media according to claim 1 to 3.

[Claim 14] In the optical recording approach which records said signal light as a hologram into the optical recording medium by irradiating signal light and a reference beam at an optical recording medium at coincidence While obtaining the signal light which holds data information on the wave front modulated spatially with the 1st space optical modulator The optical recording approach characterized by obtaining the reference beam which has the wave front modulated by the key information which prevents that said data information is read by persons other than those who were attested by the 2nd space optical modulator.

[Claim 15] The optical recording approach characterized by using said key information as the two-dimensional image or code formed in those who were attested from the information on a proper in the optical recording approach according to claim 14.

[Claim 16] The optical recording approach characterized by making information on a proper into a person's

attested fingerprint, a sign, print of a seal, facies, the iris, either of the personal identification numbers, or those combination at those [ said ] who were attested in the optical recording approach according to claim 15.

[Claim 17] The optical recording approach characterized by carrying out the Fourier transform of either of said signal light and said reference beams, or both, and carrying out incidence to said optical recording medium in the optical recording approach according to claim 14 to 16.

[Claim 18] The optical recording approach characterized by picturizing said key information as a two-dimensional image, displaying the picturized image on said 2nd space optical modulator in the optical recording approach according to claim 14 to 17, and obtaining said reference beam.

[Claim 19] The optical recording approach characterized by carrying out multiplex record of the hologram for said optical recording medium or said signal light, and said reference beam into said optical recording medium rotation or by carrying out a parallel displacement in the optical recording approach according to claim 14 to 18.

[Claim 20] The light from said light source is modulated according to the light source which emits coherent light, and data information. The 1st space optical modulator which obtains the signal light which holds said data information by the wave front, The light from said light source is modulated using the key information which prevents that said data information is read by persons other than those who were attested with the 1st image formation optical system which irradiates said signal light at an optical recording medium. Optical recording equipment equipped with the 2nd space optical modulator which obtains the reference beam which holds said key information by the wave front, and the 2nd image formation optical system which irradiates said reference beam at said optical recording medium.

[Claim 21] Optical recording equipment characterized by using said key information as the two-dimensional image or code formed in those who were attested from the information on a proper in optical recording equipment according to claim 20.

[Claim 22] Optical recording equipment characterized by making information on a proper into a person's attested fingerprint, a sign, print of a seal, facies, the iris, either of the personal identification numbers, or those combination at those [ said ] who were attested in optical recording equipment according to claim 21.

[Claim 23] Optical recording equipment characterized by carrying out the Fourier transform of either of said signal light and said reference beams, or both, and carrying out incidence to said optical recording medium in optical recording equipment according to claim 20 to 22.

[Claim 24] The optical recording equipment concerned is optical recording equipment characterized by picturizing said key information as a two-dimensional image further in optical recording equipment according to claim 20 to 23, displaying the picturized image on said 2nd space optical modulator, and having the image sensor to which said reference beam is made to output from said 2nd space optical modulator.

[Claim 25] Optical recording equipment characterized by carrying out multiplex record of the hologram for said optical recording medium or said signal light, and said reference beam into said optical recording medium rotation or by carrying out a parallel displacement in optical recording equipment according to claim 20 to 24.

[Claim 26] Optical recording equipment characterized by said 1st and 2nd space optical modulators being liquid crystal space optical modulators in optical recording equipment according to claim 20 to 25.

[Claim 27] The reference beam which has the wave front modulated by the key information which prevents that said data information is read to the wave front modulated spatially by persons other than those who were attested with the signal light holding data information The hologram recorded into the optical recording medium when an optical recording medium irradiated at coincidence is read by the read-out light which has the same wave front as said reference beam. The optical reading approach of obtaining the diffracted light which has the same wave front as said signal light, and reading said data information in the wave front of the diffracted light.

[Claim 28] The optical reading approach which carries out the Fourier transform of said read-out light, and is characterized by irradiating said hologram in the optical reading approach according to claim 27.

[Claim 29] The optical reading approach which carries out the Fourier transform of said diffracted light, and is characterized by reading said data information in the optical reading approach according to claim 27 or 28.

[Claim 30] The reference beam which has the wave front modulated by the key information which prevents that said data information is read to the wave front modulated spatially by persons other than those who were attested with the signal light holding data information The read-out light optical system which

irradiates read-out light at the hologram recorded into the optical recording medium when an optical recording medium irradiated at coincidence, The optical reader characterized by reading said data information by said photodetector when the light which is equipped with the photodetector which detects the wave front of the diffracted light from said hologram, and has the wave front same as said read-out light as said reference beam is irradiated.

[Claim 31] It is the optical reader characterized by displaying the image sensor with which said read-out light optical system picturizes the information for read-out as a two-dimensional image in an optical reader according to claim 30, and the image picturized by this image sensor, and having the space optical modulator which forms the wave front of said read-out light.

[Claim 32] The optical reader which carries out the Fourier transform of said read-out light, and is characterized by irradiating said hologram in an optical reader according to claim 30 or 31.

[Claim 33] The optical reader characterized by carrying out the Fourier transform of said diffracted light, and carrying out incidence to said photodetector in an optical reader according to claim 30 to 32.

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[Translation done.]

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the information media using a hologram and the optical recording approach relevant to this, optical recording equipment, the optical reading approach, and an optical reader, in order to prevent forgery [ commuter pass / a credit card, a bank card, a prepaid card, a memory card, an identification card, a check a passbook, a stock certificate, a promissory note a ticket, a coupon ticket ], alteration, a copy, a data alteration, or an unauthorized use.

[0002]

[Description of the Prior Art] As for various kinds of above information media, forgery, alteration, a copy, a data alteration, or an unauthorized use is made in many cases. Therefore, in the field thru/or system treating these information media, in order to prevent forgery, alteration, a copy, a data alteration, or an unauthorized use, various devices are made.

[0003] For example, the magnetic card which has generally spread widely has an open data-logging part, and since read/write can be carried out freely, it is carrying out various works in respect of security in finance or the field of circulation. For example, in the bank or the consumer credit company, with special on-line system, he is trying to maintain total security on a pin center, large or workstation level, data for an individual check, such as a personal identification number, are recorded on the magnetic-recording part of a card, and the approach of collating a personal identification number through a ten key between a pin center, large and a card user etc. is performed, without writing in a personal identification number on the approach of collating this data and the data inputted through the card reader, or a card. moreover, a sign -- him -- there are also the field and the industry of checking.

[0004] However, the alteration of data is easy to be performed, although a magnetic card is convenient and simple. Then, in order to secure the safety for data division, a magnetic layer is made into two-layer structure, or how to encipher data is considered. However, a magnetic layer is made into two-layer structure, or only by enciphering data, it is difficult to prevent the DETTO copy in the case where a reader writer is stolen, and the case of being based on the expert of the field, the data alteration by decryption, etc., and such [ actually ] an incident has occurred.

[0005] On the other hand, while cashless payment-ization spreads, a social need is also various, for example, a prepaid card is published to shopping of a small sum, and the facilities [ small sum ] of payment are presented. Amount-of-money information is written in into magnetic information, and whenever a prepaid card is use, it reduces the use amount of money and rewrites the usable balance.

[0006] However, only for magnetic information, if it is a person with expertise, by carrying out a certain work, it will be possible to carry out read/write of the information, and incidents, such as extensive forgery of a card, a copy, or a data alteration, will actually have occurred. The semi-conductor memory card using SRAM, EPROM, EEPROM, etc. also has the same problem as what is depended on the MAG.

[0007] On the other hand, the information media using an optical recording medium are proposed. As shown in drawing 13 , to JP,2-231198,A, concretely the laser beam 61 of specific wavelength A half mirror 62 is made to penetrate, the information plate 63 which memorized information on the film is irradiated, and the light which penetrated the information plate 63 is reflected by the mirror 65 through a lens 64. As a body light 66 By making it reflect by the half mirror 62 and the mirror 68, and carrying out incidence of the laser beam 61 to the optical-recording-medium part of ID card 67 as a reference beam 69 at the same time it carries out incidence to the optical-recording-medium part of ID card 67 The approach of recording the hologram 70 of the information memorized by the information plate 63 on the optical-recording-medium part of ID card 67 is shown.

[0008] At the time of playback, the same reference beam as the reference beam 69 at the time of record is irradiated at a hologram 70, the playback light 71 is obtained, the playback light 71 is optically read with the hologram reconstruction image reader 72 which has arranged as symmetrically focusing on a hologram 70 as the information plate 63, and the information memorized by the information plate 63 is read.

[0009] To JP,6-222705,A, by moreover, the body light holding information and the reference beam non-become irregular After recording a hologram on the hologram layer 82 shown in drawing 14, as shown in this drawing The phase distribution structure 81 of having specific phase distribution as a part of hologram supporter material is attached in the front-face side of the hologram layer 82. Phase distribution which negates the phase distribution which the phase distribution structure 81 has is displayed on the phase modulation mold space optical modulator 92. The modulated light by returning to the reference beam non-become irregular and irradiating the hologram layer 82 according to the phase distribution structure 81, by modulating the laser beam 91 non-become irregular with the phase modulation mold space optical modulator 92 The method of reading the information on body light in the hologram recorded on the hologram layer 82 as a reconstruction image 93 is shown.

[0010] By this approach, concretely, as shown in this drawing (B), the phase distribution structure 81 is attached in the hologram layer 82 through an interlayer 83, and forms a protective layer 84 behind the hologram layer 82.

[0011] And since the reference beam which carries out incidence to the hologram layer 82 does not become the thing of the same wave front as the reference beam at the time of record when the phase distribution displayed on the phase modulation mold space optical modulator 92 is not a predetermined thing corresponding to the phase distribution which the phase distribution structure 81 has, information on body light cannot be read.

[0012] That is, this approach cannot use as a password key phase distribution displayed on the phase modulation mold space optical modulator 92, information on body light cannot be read in the hologram recorded on the hologram layer 82, and those who do not know phase distribution of a password key cannot read information.

[0013]

[Problem(s) to be Solved by the Invention] In order to establish the total security of various kinds of information media which were mentioned above, three elements of the safety of authentication of those who were attested, such as an owner, a rightful claimant, etc. of the truth judging of (1) information media and (2) information media, and (3) data information thru/or confidentiality \*\* must be secured to coincidence.

[0014] On the other hand, although invention indicated by JP,2-231198,A or JP,6-222705,A mentioned above is what used the hologram for solid-state authentication and (1) and (2) can be secured once, there is a problem about (3).

[0015] For example, when using invention indicated by JP,2-231198,A or JP,6-222705,A for the memory card in which an informational postscript and informational elimination are possible, a hologram record part performs truth judging and authentication, and it is possible to record data information on the magnetic-recording section different from a hologram record part, or the semiconductor memory section.

[0016] However, if it does in this way, like the magnetic card or semi-conductor memory card which were mentioned above, there is fear, such as a DETTO copy and a data alteration, and the safety of data information cannot be secured. Furthermore, a card reader is stolen, once the authentication approach using a hologram is decoded, all cardholders are exposed to the risk of an unauthorized use, all cards are collected and a card publisher has problems, such as undertaking the burden which distributes a new card.

[0017] Then, the purpose of this invention is to offer the information media which can rewrite information easily, the optical recording approach, and the optical reading approach while being able to prevent certainly forgery, alteration, a copy, a data alteration, and an unauthorized use.

[0018]

[Means for Solving the Problem] The information media of this invention should be modulated in the information media which recorded the hologram on the hologram record section using the key information which prevents that said data information is read by persons other than those who were especially attested in said 2nd wave front by making the 1st wave front which has data information interfere with the 2nd wave front for reference.

[0019] In this case, as for that key information, it is desirable to consider as the two-dimensional image or code formed in those who were attested from the information on a proper, and, as for the information on a proper, it is desirable to carry out with a person's attested fingerprint, a sign, print of a seal, facies, the iris, either of the personal identification numbers, or those combination to those [ those ] that were attested.

[0020] By the optical recording approach of this invention, signal light and a reference beam by irradiating an optical recording medium at coincidence While obtaining the signal light which holds data information on the wave front spatially modulated by the 1st space optical modulator in the optical recording approach which records said signal light as a hologram into the optical recording medium The reference beam which has the wave front modulated by the key information which prevents that said data information is read by persons other than those who were attested by the 2nd space optical modulator is obtained.

[0021] The signal light which holds data information on the wave front modulated spatially by the optical reading approach of this invention, When an optical recording medium irradiates at coincidence, the reference beam which has the wave front modulated by the key information which prevents that said data information is read by persons other than those who were attested The hologram recorded into the optical recording medium is read by the read-out light which has the same wave front as said reference beam, the diffracted light which has the same wave front as said signal light is obtained, and said data information is read in the wave front of the diffracted light.

[0022]

[Function] Holography is divided into the phase which records a hologram, and the phase to reproduce.

record -- a phase -- \*\*\*\* -- drawing 2 -- (-- A --) -- being shown -- as -- information -- having -- a signal -- light -- (-- Ep --) -- three -- a reference beam -- (-- Ef --) -- four -- the hologram record medium 2 -- coincidence -- irradiating -- the inside of the hologram record medium 2 -- both interference fringe -- recording . Permeability T at this time T- (Ap+Af) (Ap\*+Af\*)

$$= |Ap|^2 + |Af|^2 + ApAf^* + AfAp^* \quad (1)$$

It is come out and expressed. However, Ap and Af are the complex amplitude in the field of  $z=0$  of light waves Ep and Ef, respectively.

[0023] playback -- a phase -- \*\*\*\* -- drawing 2 -- (-- B --) -- being shown -- as -- record -- the time -- a reference beam -- (-- Ef --) -- four -- being the same -- read-out -- light -- (-- Ef --) -- five -- the hologram record medium 2 -- irradiating . At this time, the electric field Ac of the light wave (Ec) 6 diffracted rightward [ of the hologram record medium 2 ] are  $Ac = T Af - (|Ap|^2 + |Af|^2) Af + |Af|^2 Ap + Af^2 Ap^*$ . -- (2)

It is come out and given and only the 2nd term fulfills the conditions of Bragg. The 2nd term  $Ac - |Af|^2 Ap$  -- (3)

Come out, and it is, has a phase factor  $\exp [-i(kp) \text{ and } r]$ , and will have the same wave front as the signal light (Ep) 3 by  $z > 0$ .

[0024] And information cannot be read [ what kind of information is recorded and ], even if it only sees from outside or irradiates the read-out light of the wave front non-become irregular, since it is hologram-ized by the wave front modulated by specific key information and has become an interference fringe by it. Moreover, in record of a hologram, with classes of light source used for signal light and a reference beam, such as wavelength, the include angle of a reference beam, etc., since the locations of a reconstruction image etc. differ, if the conditions of the hologram record are not known, a duplicate is difficult and safety improves greatly.

[0025] Furthermore, in this invention, persons other than those (henceforth "him") who were attested can realize the ultimate security system that a card cannot be accessed, by the following approaches.

[0026] Namely, while arranging the 1st space optical modulator, coding or two-dimensional imaging and expressing data information with the need of rewriting [ amount of money ] to this, into the optical path of signal light as the optical recording approach of this invention The 2nd space optical modulator is arranged in the optical path of a reference beam, and a fingerprint, a sign, etc. of him display key information, such as a two-dimensional image formed from the information on a proper at him, or a code, on this.

[0027] And the light which passed the 2nd space optical modulator is irradiated as a reference beam at a hologram record medium at the same time it irradiates the light which passed the 1st space optical modulator as a signal light at a hologram record medium. Signal light and a reference beam interfere in a hologram record medium, and a hologram is recorded by this.

[0028] The read-out light which has the wave front modulated by key information, such as a two-dimensional image which had namely, formed the same wave front as the reference beam at the time of record in him, such as a fingerprint, a sign, etc. of him, from the information on a proper, or a code, at the time of playback is irradiated at a hologram record medium. The diffracted light which has the same wave front as signal light is obtained from a hologram record medium by this. The data information which signal light has can be read by detecting this diffracted light with photodetectors, such as CCD.

[0029] Unless a fingerprint, a sign, etc. of him are depended on key information, such as a two-dimensional image formed in him from the information on a proper, or a code, at the time of playback according to the



optical recording approach of this invention, the recorded data information cannot be read. therefore, read-out of the data currently recorded on the card even if a third person gets a card and a reader writer to coincidence and clarifies the mechanism of the data logging -- him -- except is impossible.

[0030] Namely, the information media of this invention become what data information was recorded on after having been locked by the above-mentioned key information for every media, and can secure the safety of data information for those [ every ] who were attested. Authentication of those with whom information media were attested [ with whom were attested and it was truth-judged ] is also secured to coincidence using the key information. Therefore, according to this invention, forgery of information media, alteration, a copy, a data alteration, and an unauthorized use can be prevented completely.

[0031] Moreover, if elimination and a postscript of a hologram are possible for the information media of this invention, the hologram record medium which forms that hologram record section After eliminating the hologram holding front data information in the system treating information media By modulating signal light by new data information, modulating a reference beam using the above-mentioned key information, and newly recording a hologram Data information can be rewritten easily and correspondence becomes possible easily like a prepaid card also about what needs to rewrite data information, such as the amount of money, at every use.

[0032] Thus, in this invention, since hologram record is carried out using the reference beam which formed all data in him from the fingerprint which is the information on a proper, the sign, etc., forgery, alteration, a copy, a data alteration, and an unauthorized use can be prevented certainly.

[0033]

[Embodiment of the Invention]

[Operation gestalt as information media] drawing 1 shows an example of the information media of this invention, and those information media 1 form the hologram record section 2 of the card represented by a credit card, the prepaid card, etc. which turns into a field from a hologram record medium in part, and record a hologram by the approach mentioned above to that hologram record section 2.

[0034] As long as the hologram record medium 2 can carry out hologram record, what kind of thing is sufficient as it. For example, the polymeric materials and the photorefractive ingredient in which photoisomerization is shown, the polymeric materials containing the coloring matter in which photofading is shown, a photopolymer, liquid crystal, etc. can be used. However, when performing informational elimination and postscript, polymeric materials and the photorefractive ingredient in which photoisomerization is shown are suitable. A hologram record medium is further shown in a detail in the place of the example mentioned later.

[0035] [Operation gestalt of optical recording approach and optical recording equipment] drawing 5 shows 1 operation gestalt of the optical recording approach of this invention, and optical recording equipment. The light source 10 should just emit the coherent light of the wavelength which has sensibility in the hologram record medium 2. The example of drawing is the case where 515nm of oscillation lines of an Ar ion laser is used.

[0036] Make a half mirror 11 penetrate, it is made to reflect by the mirror 21, and the laser beam from this light source 10 is made into parallel light with a lens 22, and carries out incidence to the space optical modulator 23. As a space optical modulator 23, the liquid crystal panel of an electrical-potential-difference address type, the thing which attached the matrix electrode to the electro-optics crystal can be used.

[0037] In this example, the liquid crystal space optical modulator 40 as shown in drawing 7 is used as a space optical modulator 23. The liquid crystal layer 41 was pinched with transparent electrodes 42 and 43, the polarizing plates 44 and 45 which crossed the outside mutually were arranged, and the liquid crystal space optical modulator 40 can modulate the amplitude thru/or reinforcement of incident light.

[0038] The data information which should be recorded on a hologram is a computer 24, and modulates luminous intensity, a phase, or polarization etc. which carries out incidence to the space optical modulator 23 to two-dimensional according to the data information which codes, uses as two-dimensional digital data, or should output to the space optical modulator 23 from a computer 24 as two-dimensional image information of an analog, should display on the space optical modulator 23, and should be recorded. However, since the liquid crystal space optical modulator 40 shown in drawing 7 is used for this example as a space optical modulator 23, only reinforcement is modulated.

[0039] Thus, according to data information, reinforcement carries out the Fourier transform of the light which passed the space optical modulator 23 modulated by two-dimensional by Fourier transformer lens 25 as a signal light 3, and irradiates the hologram record medium 2.

[0040] On the other hand, it is made to reflect by the half mirror 11 and the mirror 31, and the laser beam

from the light source 10 is made into parallel light with a lens 32, and carries out incidence to the space optical modulator 33. In this example, the liquid crystal space optical modulator 40 as shown in drawing 7 as well as [ as a space optical modulator 33 ] the space optical modulator 23 is used.

[0041] As key information, the example using the two-dimensional image formed from his fingerprint is shown. "He" pushes the fingerprint of a predetermined finger on a position. The fingerprint is picturized with the image sensors 34, such as CCD and a photodetector array, two-dimensional image information is obtained from an image sensor 34, the two-dimensional image information is outputted to the space optical modulator 33, and is displayed on the space optical modulator 33, and the luminous intensity which carries out incidence to the space optical modulator 33 is modulated to two-dimensional according to the two-dimensional image of key information.

[0042] According to this key information, reinforcement carries out the Fourier transform of the light which passed the space optical modulator 33 modulated by two-dimensional by Fourier transformer lens 35 as a reference beam 4, and irradiates the hologram record medium 2 at the above-mentioned signal light 3 and coincidence.

[0043] The signal light 3 modulated by data information in the hologram record medium 2 by this and the reference beam 4 modulated by key information interfere, and the signal light 3 holding data information is recorded as a hologram.

[0044] Drawing 8 shows the example of the signal light 3 in this case, and a reference beam 4. A reference beam 4 is modulated by his fingerprint, as mentioned above. However, the image of a reference beam 4 needs to be a positive image in this case. Even when a third person's fingerprint is used so that it may mention later that a reference beam 4 is a negative image at the time of playback, there is a possibility that the data information which the signal light 3 has may be read by the high part of the lightness of the outside of the fingerprint part of read-out light. However, if the image of only the core of a fingerprint is captured and the part of whenever [ Takaaki ] is not produced on the outside of a fingerprint part, it is good also considering a reference beam 4 as a negative image. Also with the signal light 3, as shown in the left-hand side of this drawing, it is an alphabetic character image etc., and when considering as a negative image, in producing the part of whenever [ Takaaki ] outside, it makes it a positive image.

[0045] Although the above-mentioned example is the case where a fingerprint is used for him as information on a proper, a signature, print of a seal (seal), facies (photograph of his face), the iris (iris), a personal identification number, etc. can be used for it. What is necessary is to be the same as that of a fingerprint, and just to picturize with an image sensor 34 about a sign or print of a seal.

[0046] About facies or the iris, he is in the condition which turned to the predetermined direction, and should just picturize with a video camera etc. What is necessary is just to picturize the written thing about a personal identification number, when he writes this. Or what is necessary is to recognize by character recognition etc., to decide a number, and to generate the two-dimensional digital data according to the number, or two-dimensional image information, or to read from storage, and just to display on the space optical modulator 33. It is also the same as when inputting a personal identification number with a ten key.

[0047] Those who were attested may be not only an individual but a family, a group, etc. In that case, a pattern, a pattern, etc. common to the constituent can be defined, and everybody can draw it instead of a sign, or the approach of inputting a personal identification number common to a constituent can be taken.

[0048] [Operation gestalt of optical reading approach and optical reader] drawing 6 shows 1 operation gestalt of the optical reading approach of this invention, and an optical reader. Data information is recorded on the hologram record medium 2 by the approach mentioned above.

[0049] As the light source 10, the same thing as the thing at the time of record is used. Like the reference beam optical system at the time of record, it is made to reflect by the half mirror 11 and the mirror 31, and the laser beam from this light source 10 is made into parallel light with a lens 32, and carries out incidence to the space optical modulator 33. If it is the case where a fingerprint is used at the time of record, when "he" pushes a fingerprint like the time of record, the same two-dimensional image information as the time of record will be displayed on the space optical modulator 33, and the read-out light 5 which has the same wave front as the reference beam 4 at the time of record as a light which passed the space optical modulator 33 will be obtained.

[0050] The Fourier transform of this read-out light 5 is carried out by Fourier transformer lens 35, and the hologram record medium 2 is irradiated. Thus, when incidence of the read-out light 5 which has the same wave front as the reference beam 4 at the time of record is carried out to the hologram record medium 2, the light wave 6 diffracted rightward [ of the hologram record medium 2 ] has the same wave front as the signal light 3 so that clearly from a formula (3). And since the Fourier transform of the signal light 3 in the

hologram record medium 2 is carried out by Fourier transformer lens 25, the reconstruction image of the signal light 3 is observable in the focal plane of Fourier transformer lens 36 by carrying out the inverse Fourier transform of the diffracted light 6 by Fourier transformer lens 36. The photodetectors 37, such as CCD and a photodetector array, detect this reconstruction image, and the data information which the signal light 3 has is read.

[0051] If a hologram is irradiated by the read-out light of a different wave front from the reference beam 4 at the time of record, in order not to fill phase matching conditions with this invention, the signal light 3 is not reproduced correctly. namely, him -- since a fingerprint, a sign, etc. of him are unreproducible even if the third person of an except is going to read data information in a hologram, data information cannot be read.

[0052] Drawing 9 and drawing 10 are what showed the situation, and drawing 9 is the case where he read the signal light 3 as the diffracted light 6, and acquires data information with his fingerprint. On the other hand, by the case where others to whom drawing 10 differs from him at the time of record try to read the signal light 3 with their fingerprint, since fingerprints differ, the signal light 3 is not read but produces a little bright part in the magnitude of an optical spot as a reconstruction image.

[0053] Since the Fourier transform of the signal light 3 and the reference beam 4 is carried out at the time of record, the hologram record medium 2 irradiates, the Fourier transform of the read-out light 5 carries out and a hologram record medium 2 irradiates also at the time of playback, even if there is a location gap of a fingerprint, a sign, etc. at the time of playback, it reads in respect of the Fourier transform, it is changeless to the spatial frequency of light 5, and there is an advantage which can disregard the effect of playback degradation by location gap of a fingerprint, a sign, etc. with the above-mentioned operation gestalt.

[0054] In a [implementation gestalt of volume multiplex hologram record] volume hologram, two or more holograms can be recorded in the same volume by wavelength change of the light source, include-angle change of a reference beam, wave-front change of a reference beam, etc., and large-capacity-izing of record is possible. Each multiplex system is called wavelength multiplexing, include-angle multiplex, and phase code multiplex.

[0055] Shift multiplex system (2514 SPIE Vol. 355) is in a kind of include-angle multiplex system. This uses a spherical wave for a reference wave, by migration of a hologram record medium, acquires the same effectiveness as include-angle multiplex system, and records two or more holograms in the same volume. Moreover, not a spherical wave but the approach using the speckle pattern made with the fiber is in a reference wave (22 OPTICS LETTERS Vol. 739 (1997)). With any shift multiplex system, a hologram record medium or several micrometers incident light can be moved all over the record section of several mmphi, and multiplex record of two or more holograms can be carried out. It depends for this movement magnitude on the thickness of a hologram medium, refractive-index variation, and the wave-front configuration of a reference beam.

[0056] With the desirable operation gestalt of the optical recording approach of this invention shown and mentioned above to drawing 5, since two-dimensional images formed in him from the information on a proper, such as a fingerprint and a sign, and the Fourier transform image of a code are used for a reference beam 4, the wave front of a reference beam 4 differs from a plane wave greatly, and is suitable for shift multiplex record. On the other hand, since a plane wave is used for a reference beam in the usual hologram record, the volume multiplex record by migration of a hologram record medium is impossible.

[0057] In carrying out volume multiplex record, after carrying out hologram record of the data of the 1st sheet by the approach shown in drawing 5, data are read by the approach shown in drawing 6. The hologram record medium 2 is moved in the direction shown by arrow-head 2a thru/or the direction perpendicular to the optical axis of the read-out light 5 until the diffracted light 6 from a hologram goes out at this time. If movement magnitude at this time is set to delta, two or more new data are recordable all over the same field by moving the hologram record medium 2 at intervals of this delta. That is, the multiplex record of two or more holograms can be carried out only by moving the hologram record medium 2 slightly all over a record section. Instead of the hologram record medium 2, the signal light 3 and a reference beam 4 may be moved.

[0058] Thus, large capacity-ization of record by the volume multiplex which is one of the descriptions of hologram record is realizable only by migration of the hologram record medium 2 with this invention.

[0059] [Rewriting of data information] In this invention, data information can be rewritten by using the thing in which elimination and a postscript of data are possible as a hologram record medium 2, so that it may mention later. In this case, after those who use information media equipped with the hologram record medium 2 in the system containing optical recording equipment and an optical reader check that it is "him" If it is the case of a prepaid card, the use amount of money will be reduced and data processing of

computing the usable balance will be performed. For example, subsequently The data information currently recorded on the hologram record medium 2 is eliminated by the approach defined according to the ingredient of the hologram record medium 2, such as irradiating light extensively at the hologram record medium 2, or applying heat.

[0060] Subsequently, in a system, data information which should newly be written in the hologram record medium 2, such as the usable balance, is recorded on the hologram record medium 2 as a hologram by the completely same approach as having mentioned above. Data are rewritable with this. As well as rewriting when leaving front data information and adding new data information to this, this can once be added by saving in the system in the phase which read front data information.

[0061] Incidentally invention of JP,6-222705,A shown and mentioned above to drawing 14 Although it is not what meant rewriting from the first, it is the record medium of this JP,6-222705,A. When it was going to rewrite, after removing the phase distribution structure 81 shown in drawing 14 from the hologram layer 82 After eliminating the hologram in the hologram layer 82 and recording a new hologram, the phase distribution structure 81 must be again stuck on the hologram layer 82, and it is surmised that rewriting is difficult.

[0062]

[Example] As [ show / as a hologram record medium / in (a) drawing 3 / specifically ] The polyester which has a cyano azobenzene in a side chain, the PVA (polyvinyl alcohol) film which distributed the Methyl Orange shown at (b) drawing 4 (A), (c) PMMA (polymethylmethacrylate) film which distributed Methyl Red shown in drawing 4 (B), (d) Iron dope LiNbO<sub>3</sub>, (e) BaTiO<sub>3</sub>, PVA film containing the erythrosin B shown in (f) drawing 4 (C), (g) The PVA film containing the eosine Y shown in drawing 4 (D), the PVA film containing the uranine shown in (h) drawing 4 (E), the (i) photopolymer, etc. are used.

[0063] Since photoisomerization of an azo molecule shows form birefringence, the poly membrane which has the molecule of azo systems, such as polyester which has a cyano azobenzene in a side chain, Methyl-Orange distribution PVA film, and Methyl Red distribution PMMA film, can be used as a rewritable hologram record medium. These can write in new data information by the approach mentioned above, after eliminating data information by irradiating light extensively at a hologram record medium, or applying heat.

[0064] Photorefractive ingredients, such as iron dope LiNbO<sub>3</sub> and BaTiO<sub>3</sub> and a compound giant molecule given in "NATURE Vol.371 (1994) 671", are widely known as a rewritable hologram record medium. With an exposure or heating of light, this can also write in new data information, after eliminating data information.

[0065] Since change of an absorption coefficient and a refractive index is produced by the photochromism of a xanthene dye, xanthene dye distribution poly membranes, such as erythrosin B content PVA film, eosine Y content PVA film, and uranine content PVA film, can be used as a hologram record medium.

[0066] Since refractive-index change is produced by the photopolymerization reaction, a photopolymer can be used as a write-once hologram record medium.

[0067] Here, the example which is one of the polymeric materials which show photoisomerization, which was shown in drawing 3 and which was actually performed at the time of using for a side chain the polyester which has a cyano azobenzene is shown. It checked according to the optical system which shows that hologram record of this ingredient is possible to drawing 11 .

[0068] 515nm of oscillation lines of the Ar ion laser which has sensibility in the polyester which has a cyano azobenzene in a side chain was used for the light source 10. Polarization of the laser beam from the light source 10 is s-polarized light (perpendicular to space).

[0069] it is made to reflect by the mirror 31 and incidence of the laser beam from the light source 10 is carried out to sample 2' as reference beam 4' at the same time make a half mirror 11 penetrate, it makes it reflect by the mirror 21 and it carries out incidence of the laser beam from the light source 10 to sample 2' as signal light 3', as shown in this drawing (A) at the time of record -- making -- sample 2' -- a hologram is recorded on inside. At the time of playback, as shown in this drawing (B), signal light 3' is intercepted with a shutter 51, incidence only of reference beam 4' is carried out to sample 2', the hologram diffracted light 6 is obtained from sample 2', and a photodetector 52 detects.

[0070] Chart lasting time was changed for the optical power of signal light 3' and reference beam 4' as [ both ] 100mW, and above-mentioned record and playback were performed by turns. Both the beam diameters of signal light 3' and reference beam 4' are about 100 micrometers.

[0071] Introduction and signal light 3' and reference beam 4' performed hologram record for 5 seconds, and the hologram was read by reference beam (read-out light) 4' after that. Optical power of reference beam 4' at

the time of read-out was also set to 100mW. Since read-out of a hologram had a possibility of breaking the recorded hologram, it was performed by the sufficiently short time amount for about 0.5 seconds, and repeated this below.

[0072] Drawing 12 is what showed the dependency over the hologram chart lasting time of the reinforcement of diffracted-light 6' in the case of being based on this experiment, and is understood that hologram record of sample 2' is possible. It turns out that diffracted-light reinforcement will be in a steady state by the record for about 80 seconds. Moreover, even if it saved the recorded hologram at the room temperature and several months or more had passed, it checked that record was held.

[0073] Similarly, it checked that hologram record was possible also about the Methyl-Orange distribution PVA film, the Methyl Red distribution PMMA film, iron dope LiNbO<sub>3</sub> and BaTiO<sub>3</sub>, a photorefractive polymer, the erythrosin B content PVA film, the eosine Y content PVA film, the uranine content PVA film, and a photopolymer.

[0074] Data were recorded with the optical recording equipment shown in drawing 5 using these ingredients. 515nm of oscillation lines of an Ar ion laser mentioned above was used for the light source 10.

[0075] As data information, two steps of character strings of "FUJI XEROX" as shown in the left-hand side of drawing 8 were displayed on the space optical modulator 23, and an artificer's fingerprint of one person "Kono" was displayed on the space optical modulator 33 as key information which modulates a reference beam 4. Data information "FUJI XEROX" was created by computer 24, was inputted into the space optical modulator 23, and the fingerprint of a reference beam 4 was picturized by CCD which constitutes an image sensor 34, and it inputted it into the space optical modulator 33. By this, the hologram was recorded on the hologram record medium 2 by the approach mentioned above. In addition, the fingerprint input approach by prism given in a U.S. Pat. No. 3716301 specification can also be used for the input of a fingerprint.

[0076] It tried to read data information "FUJI XEROX" from the hologram recorded as mentioned above with the optical reader shown in drawing 6. 515nm of oscillation lines of the same Ar ion laser as the time of record was used for the light source 10. Arrangement of read-out light optical system is the same as arrangement of the reference beam optical system at the time of record. the space optical modulator 33 of read-out light optical system -- the time of record -- the same -- an artificer's fingerprint of one person "Kono" was displayed. CCD which constitutes an image sensor 34 was used for the input of a fingerprint like the time of record.

[0077] At this time, the left-hand side of drawing 9 showed the diffracted light 6 which was obtained from the hologram and detected with the photodetector 37, and checked that data information "FUJI XEROX" was reproduced faithfully.

[0078] Next, in order to investigate the effect of a location gap of the read-out light 5, the space optical modulator 33 in drawing 6 was moved in the perpendicular direction to the optical axis. Consequently, in the movement magnitude of about several mm, it is uninfluential to a reconstruction image and checked that data information "FUJI XEROX" was faithfully reproducible.

[0079] In order to check that data information "FUJI XEROX" cannot be read, the third person displayed the fingerprint of other artificers different from the time of record on the space optical modulator 33, and illuminated the hologram. Consequently, the diffracted light 6 detected with the photodetector 37 became a thing as shown in the left-hand side of drawing 10, and was not able to read data information "FUJI XEROX" at all.

[0080] Shift multiplex system performed volume multiplex hologram record. After recording the 1st data information as a hologram of the 1st sheet with the optical recording equipment shown in drawing 5, the diffracted light 6 was obtained with the optical reader of drawing 6. An artificer's fingerprint of one person "Kono" was used for the reference beam 4 and the read-out light 5 at this time. The parallel displacement of the hologram record medium 2 was made to carry out in the direction of arrow-head 2a until an image disappeared with a photodetector 37, observing the reconstruction image. At this time, when thickness used the polyester which is about 60 micrometers and which has a cyano azobenzene in a side chain as a hologram record medium 2, and about 30 micrometers was moved, the reconstruction image disappeared.

[0081] After migration, as well as the 1st sheet, an artificer's fingerprint of one person "Kono" was used for the reference beam 4, and the 2nd data information was recorded as a hologram of the 2nd sheet. Then, similarly, it moved the 30 micrometers of the 3rd and 4th data information at a time, and hologram record was carried out. After record, with the optical reader shown in drawing 6, when parallel translation of the hologram record medium 2 was carried out like the time of record, the 1st, 2nd, 3rd, and 4th data information was read every about 30 micrometers, respectively. Since the hologram record section with which the signal light 3 and a reference beam 4 lap can record the data information of four sheets every 30

micrometers to being 1mmphi extent, it is understood that volume multiplex hologram record is possible with shift multiplex system.

[0082]

[Effect of the Invention] As mentioned above, according to the information media of this invention, information cannot be read [ what kind of information is recorded and ], even if it only sees from outside or irradiates the read-out light of the wave front non-become irregular, since it is hologram-ized by the wave front modulated by specific key information and has become an interference fringe by it. Moreover, in record of a hologram, with classes of light source used for signal light and a reference beam, such as wavelength, the include angle of a reference beam, etc., since the locations of a reconstruction image etc. differ, if the conditions of the hologram record are not known, a duplicate is difficult and safety improves greatly.

[0083] Furthermore, even when a card and a card reader are stolen by coincidence even if by [, such as a fingerprint and a sign, ] using the reference beam corresponding to the two-dimensional image and code which were formed in those who were attested from the information on a proper, it can prevent others' using a card. If a fingerprint and a sign are used for a reference beam, there is also a merit that the troublesome burden of memorizing a personal identification number etc. is lost.

[0084] Moreover, according to the information media of this invention, it becomes possible to give a prepaid function to a credit card and an ATM card, or to give a stamp function, and can apply as a high multifunctional card of security. If futility which will be referred to as being a free slip of paper or plastics and throwing away if a tariff face amount is used up like the conventional prepaid card will be lost if it uses as such a multifunctional card, and reentry gold is carried out to a card, periodic duty will become possible using the same card any number of times.

[0085] Thus, the information media of this invention not only can prevent completely forgery, alteration, a copy, a data alteration, and an unauthorized use, but are very excellent in respect of an application, convenience, etc. And that effectiveness is similarly acquired about the important document not only in various cards but each field, and industrial worth of this invention is a so-called size very much.

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[Translation done.]

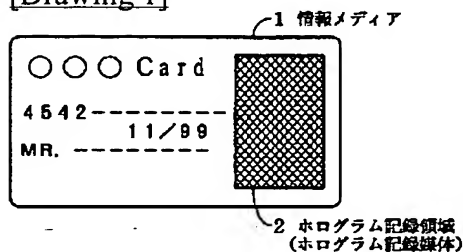
## \* NOTICES \*

JPO and NCIP are not responsible for any damages caused by the use of this translation.

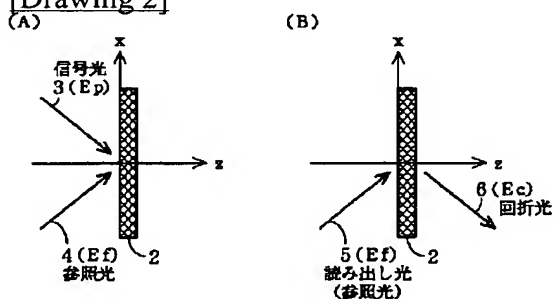
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

## DRAWINGS

[Drawing 1]

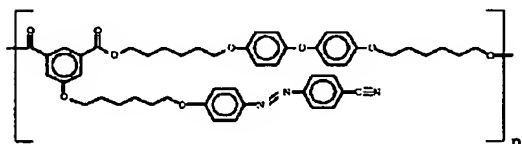


[Drawing 2]



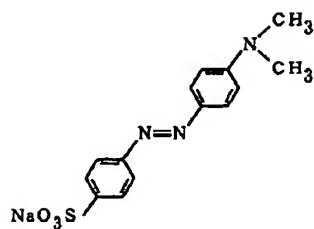
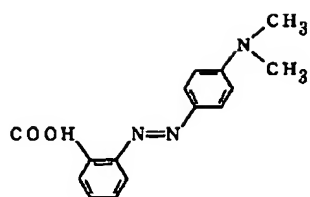
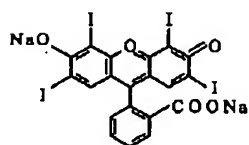
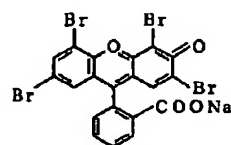
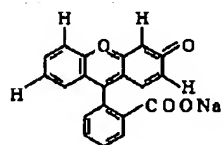
[Drawing 3]

側鎖にシアノアゾベンゼンを有するポリエステル

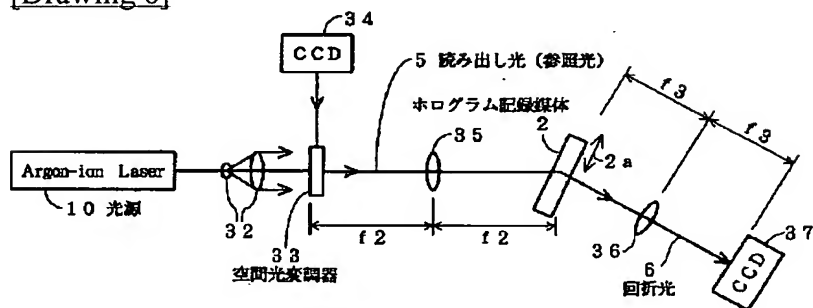


[Drawing 4]

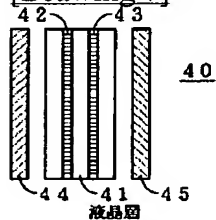


(A) メチルオレンジ(B) メチルレッド(C) エリトロシンB(D) エオシンY(E) ウラニン

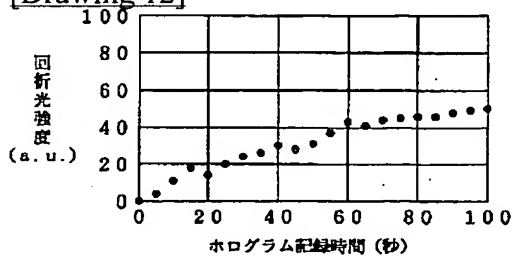
[Drawing 6]



[Drawing 7]

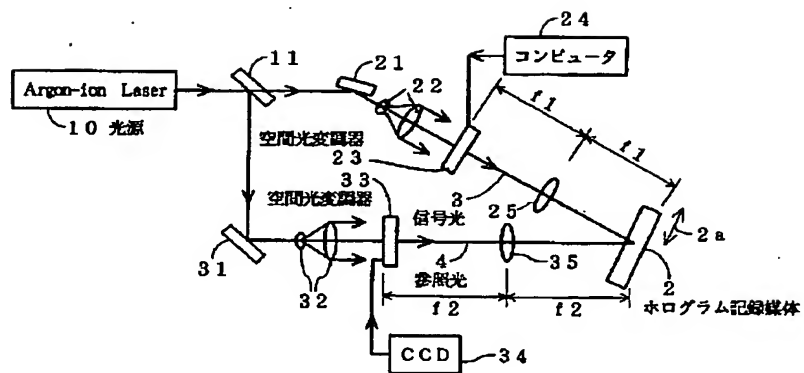


[Drawing 12]



[Drawing 5]





[Drawing 8]

信号光 (データ情報)

参照光 (本人の指紋)



[Drawing 9]

回折光 (再生像)

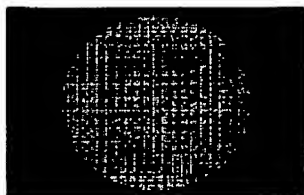
読み出し光 (本人の指紋)



[Drawing 10]

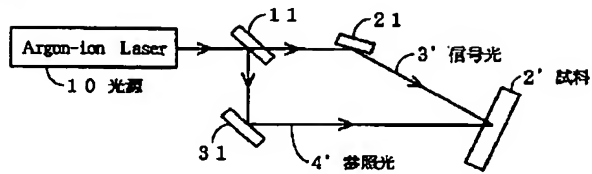
回折光 (再生像)

読み出し光 (他人の指紋)

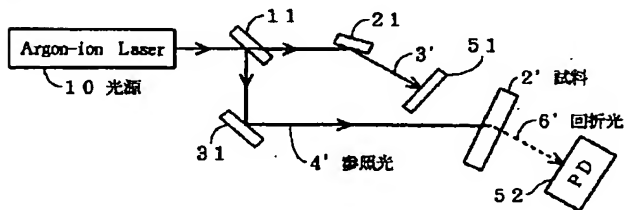


[Drawing 11]

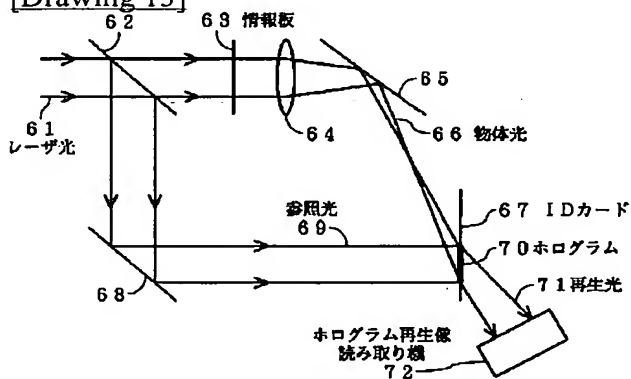
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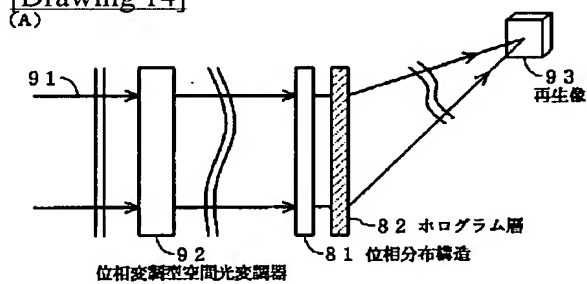
(B)



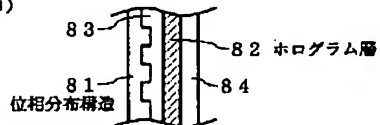
[Drawing 13]



[Drawing 14]



(B)



[Translation done.]